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**Hiramatsu**

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(54) **FIXING DEVICE**

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***G03G 15/20*** (2006.01)

(52) **U.S. Cl.**
CPC .. ***G03G 15/2053*** (2013.01); *G03G 2215/0141* (2013.01); *G03G 2215/2035* (2013.01)

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See application file for complete search history.

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(57) **ABSTRACT**

A fixing device includes a guide member including a guide portion, which is disposed downstream from a nip in a rotational direction of an endless belt and is in contact with the endless belt, and a gap forming portion, which is disposed between the nip and the guide portion in the rotational direction of the endless belt and which forms a gap from the endless belt. The gap forming portion includes an inclined surface that extends from the guide portion upstream in the rotational direction and has a predetermined area, on which a lubricant is provided. A maximum inclination angle between the predetermined area and a plane that is defined to contact a downstream end, in the rotational direction, of the contact portion of the nip member and the guide portion is less than 90 degrees.

**20 Claims, 10 Drawing Sheets**

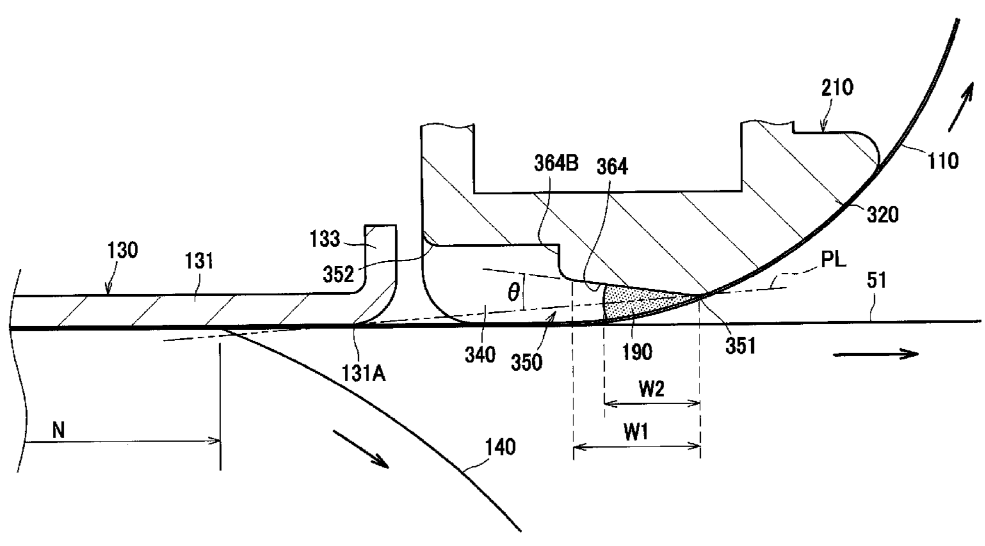


FIG.1

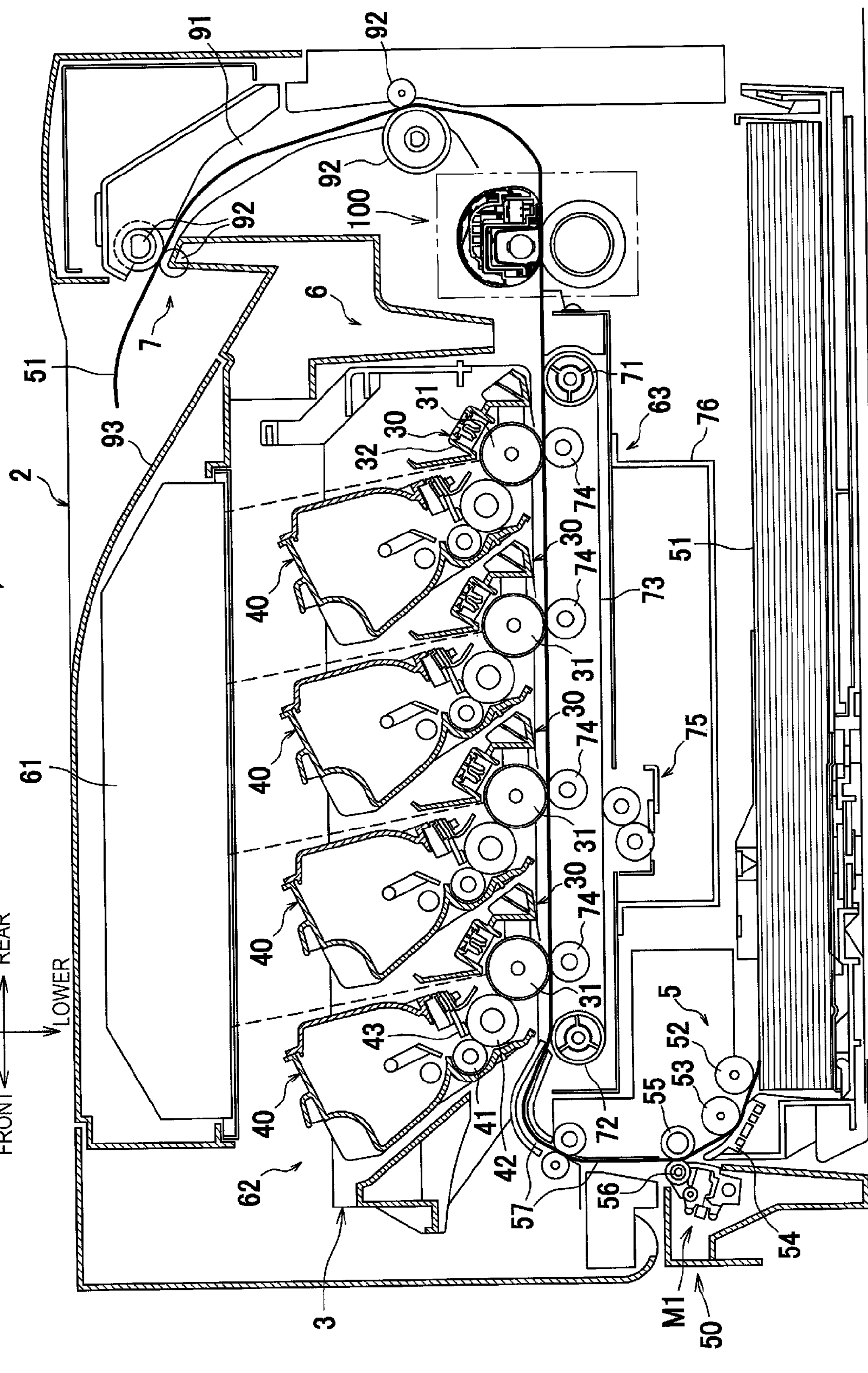
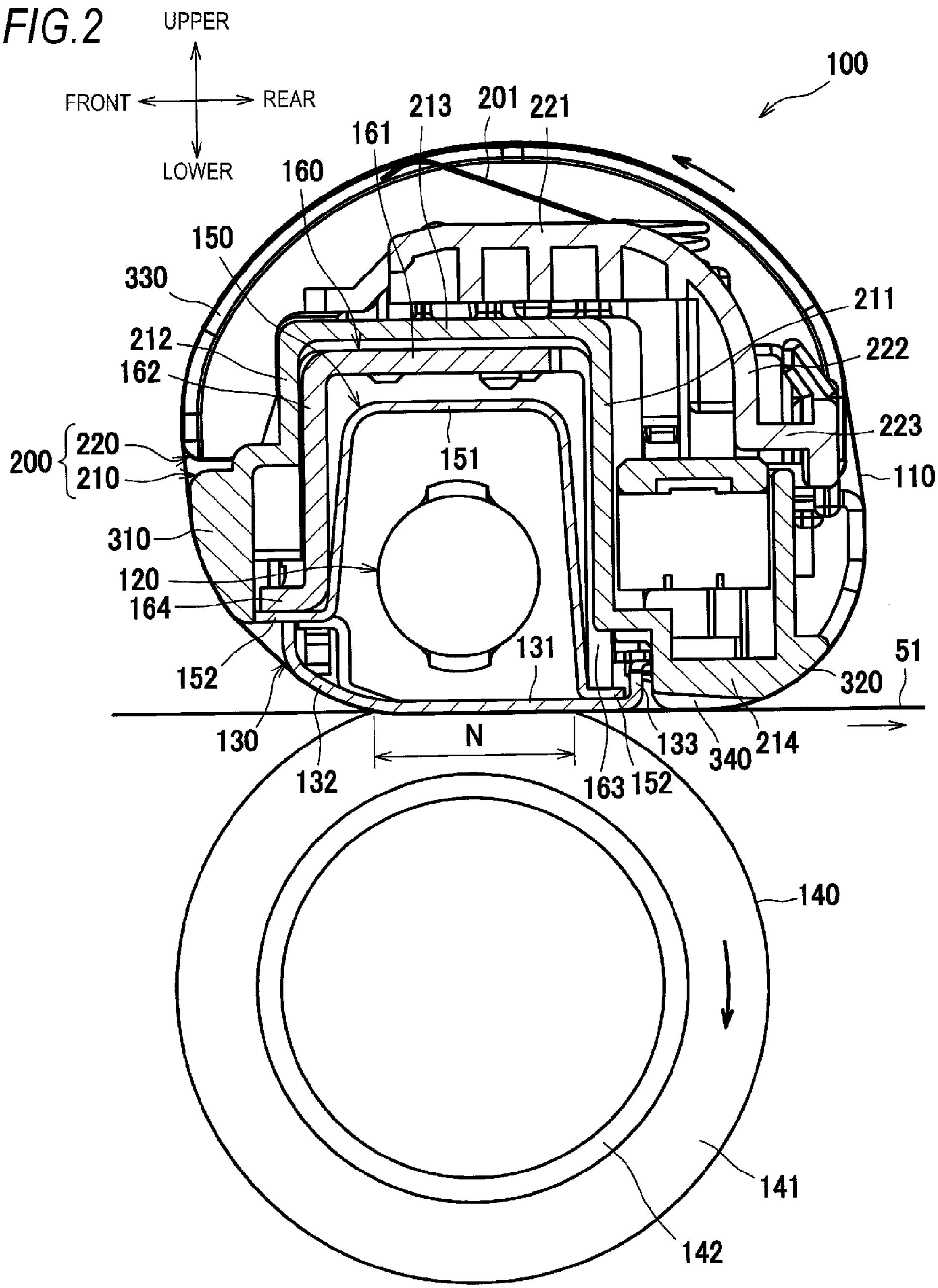


FIG.2


UPPER
FRONT
REAR
LOWER
100
213
201
221
161
160
150
330
211
212
222
162
223
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200
220
210
110
310
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51
152
320
130
N
133
340
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152
140
141
142

FIG.3

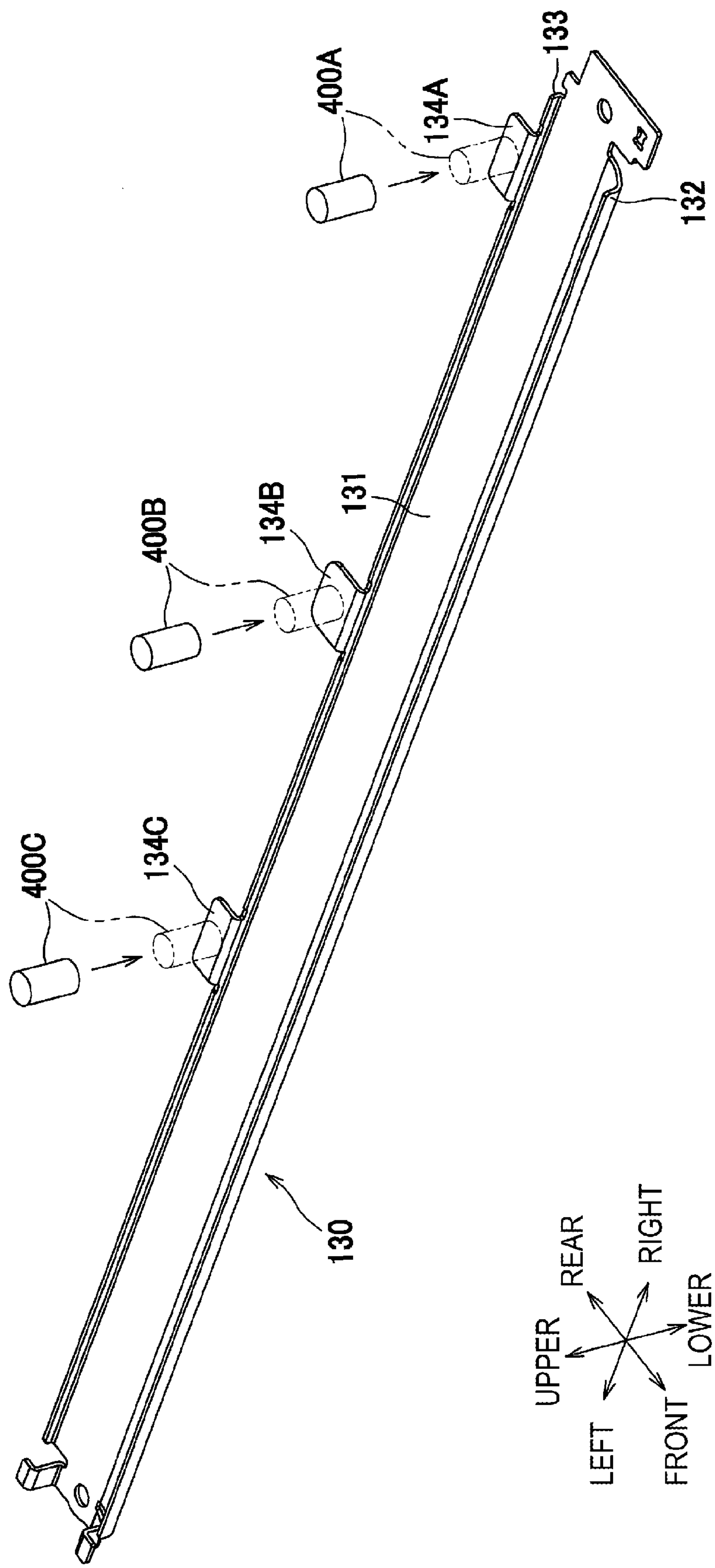
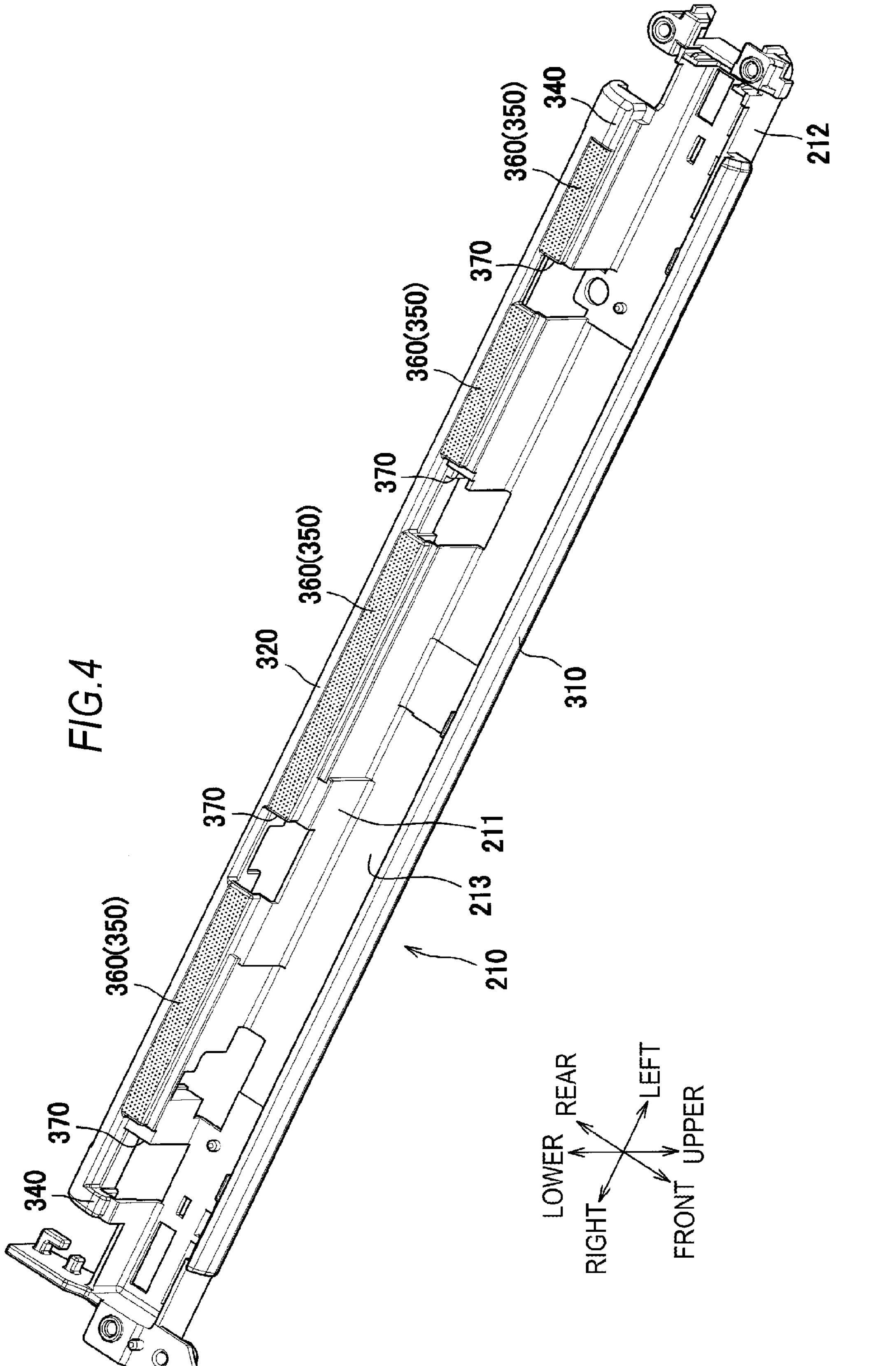

400A
134A
133
132
400B
134B
131
400C
134C
130
REAR
RIGHT
UPPER
LOWER
LEFT
FRONT

FIG.4


340
360(350)
212
370
360(350)
370
360(350)
320
310
370
211
213
360(350)
210
370
340
REAR
LEFT
LOWER
UPPER
RIGHT
FRONT

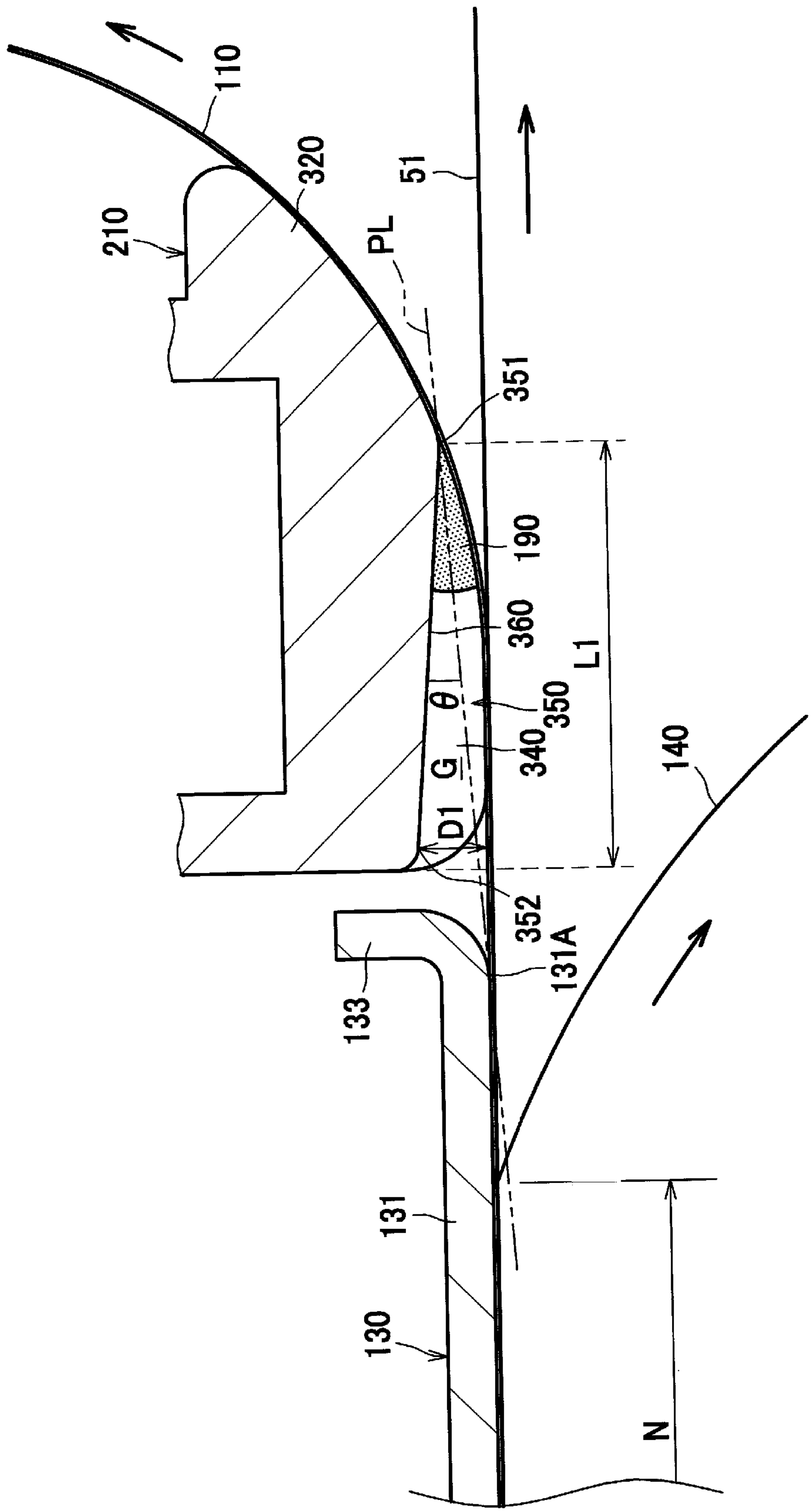
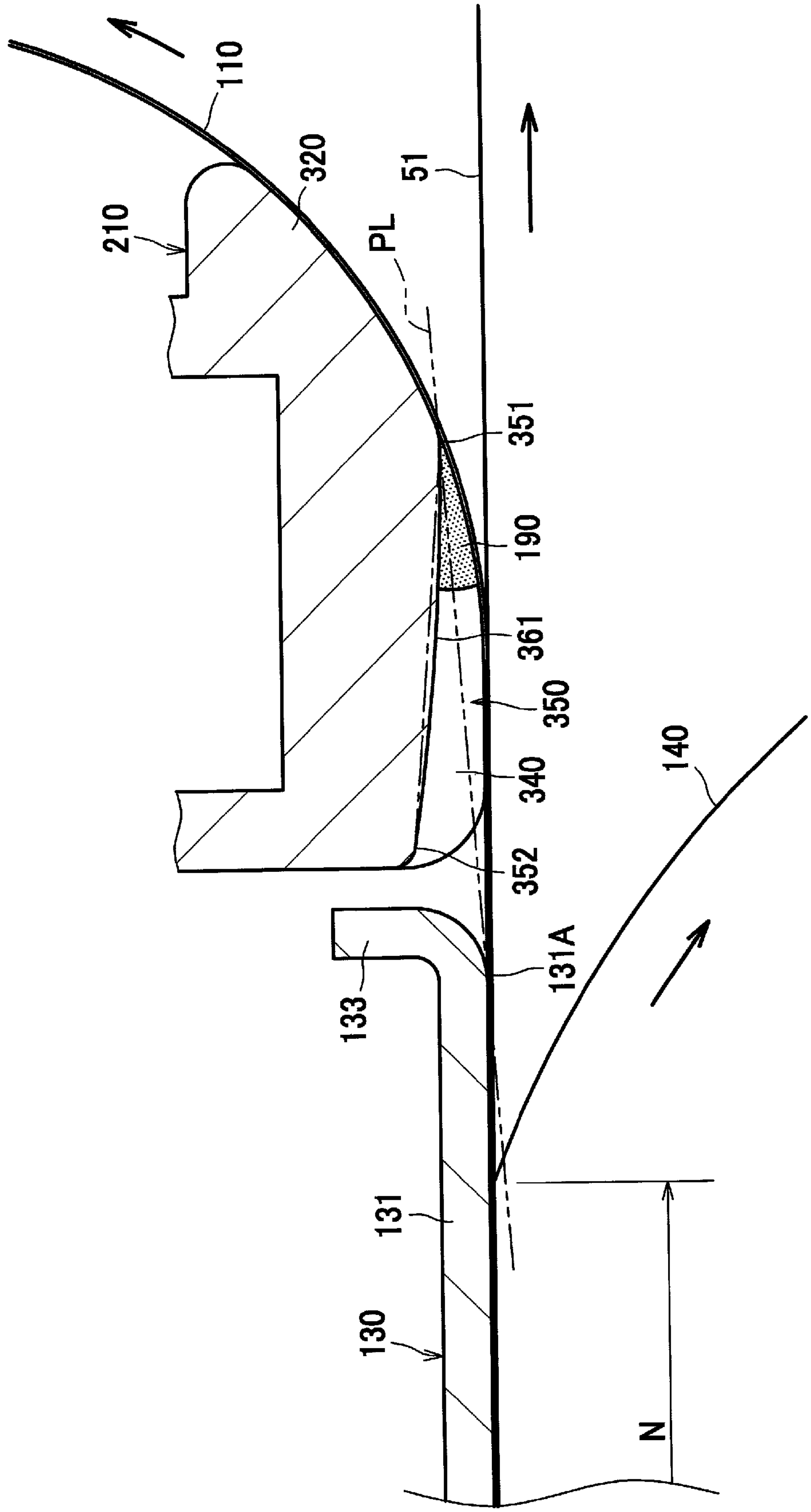

110
320
210
PL
51
351
190
360
L1
θ
350
340
G
D1
352
131A
140
133
131
130
N

FIG.5

FIG.6



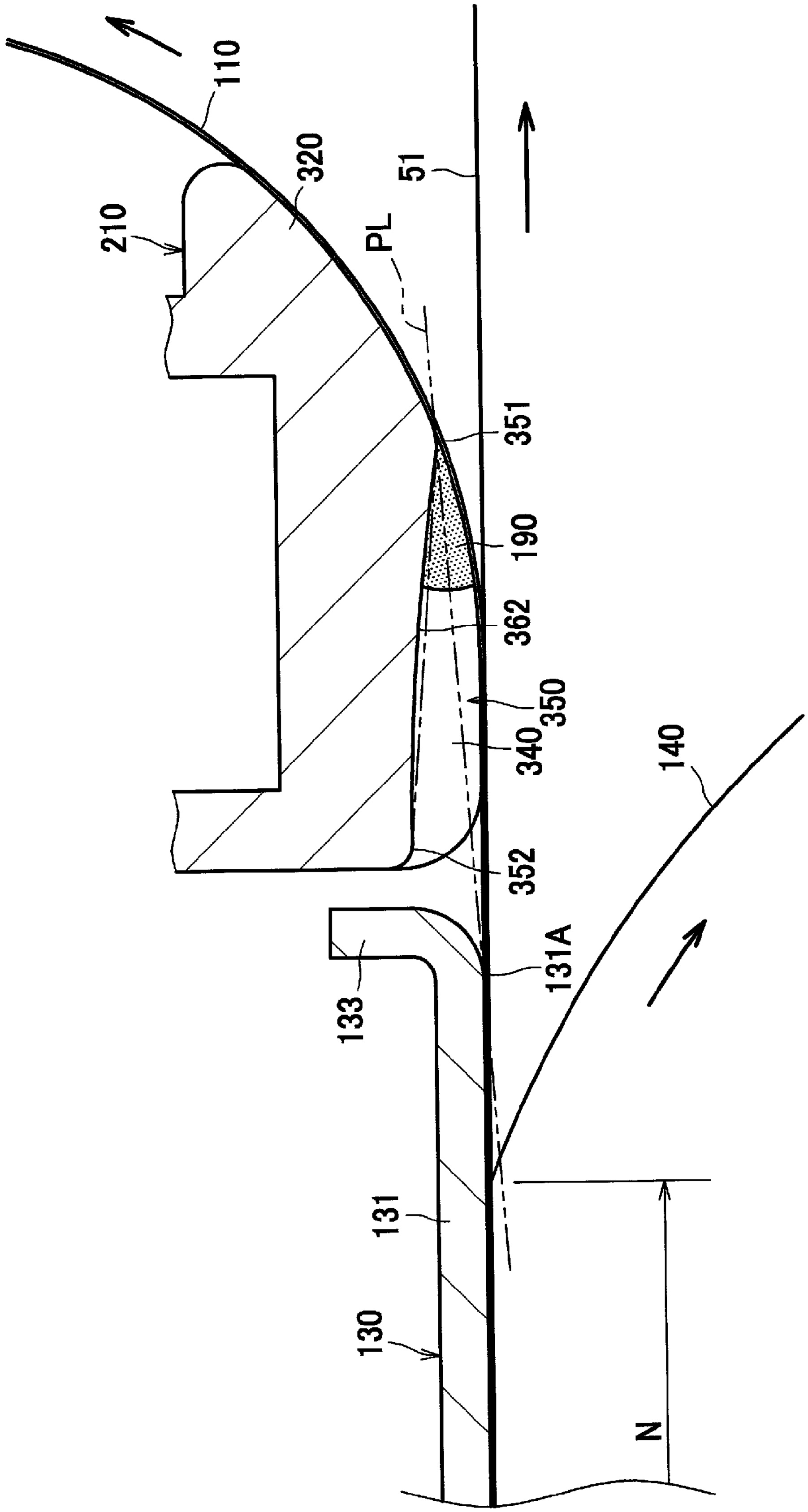



FIG.7

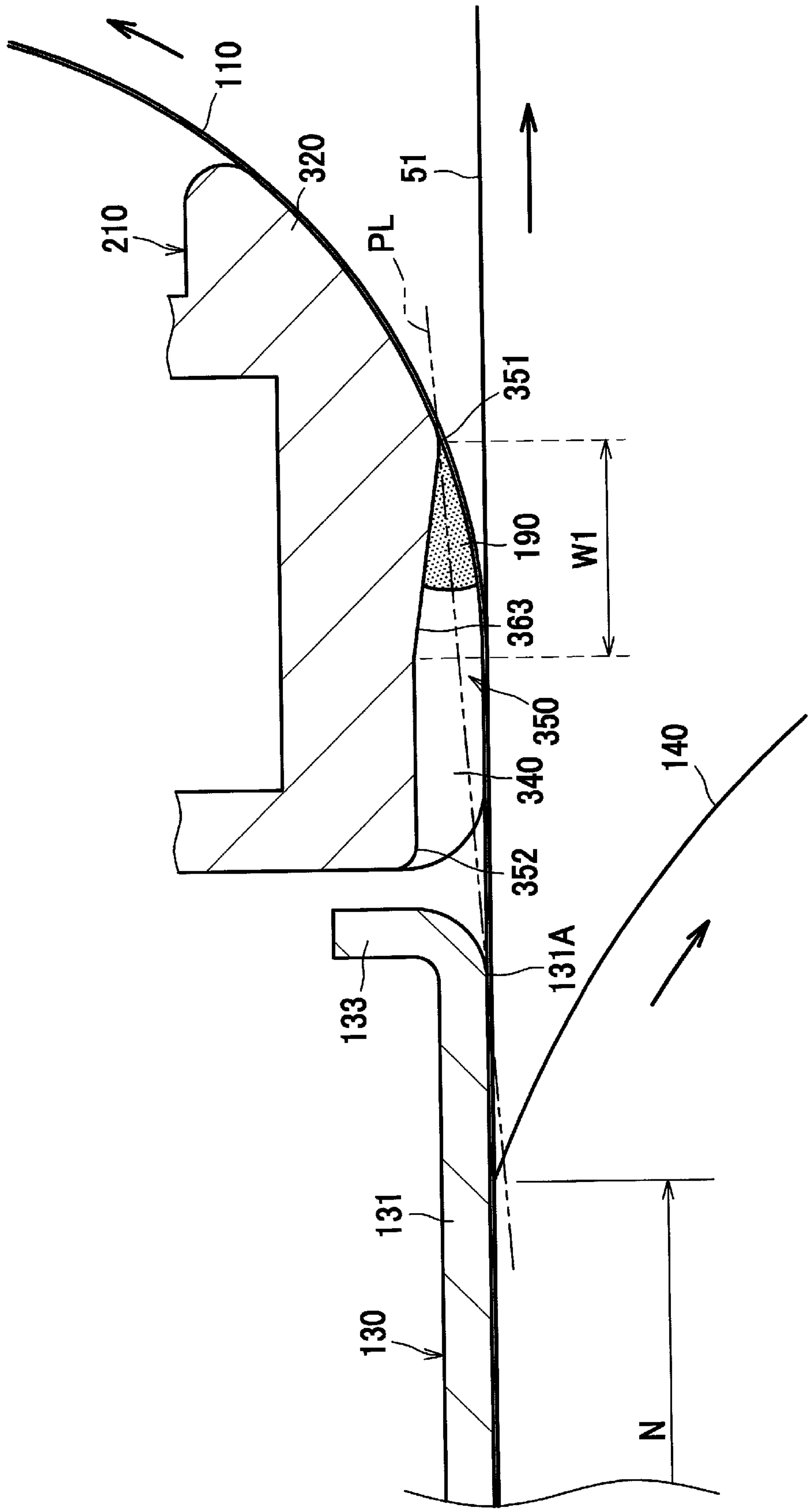

110
320
51
210
PL
351
190
W1
363
350
340
140
352
131A
133
131
130
N

FIG.8

FIG.9

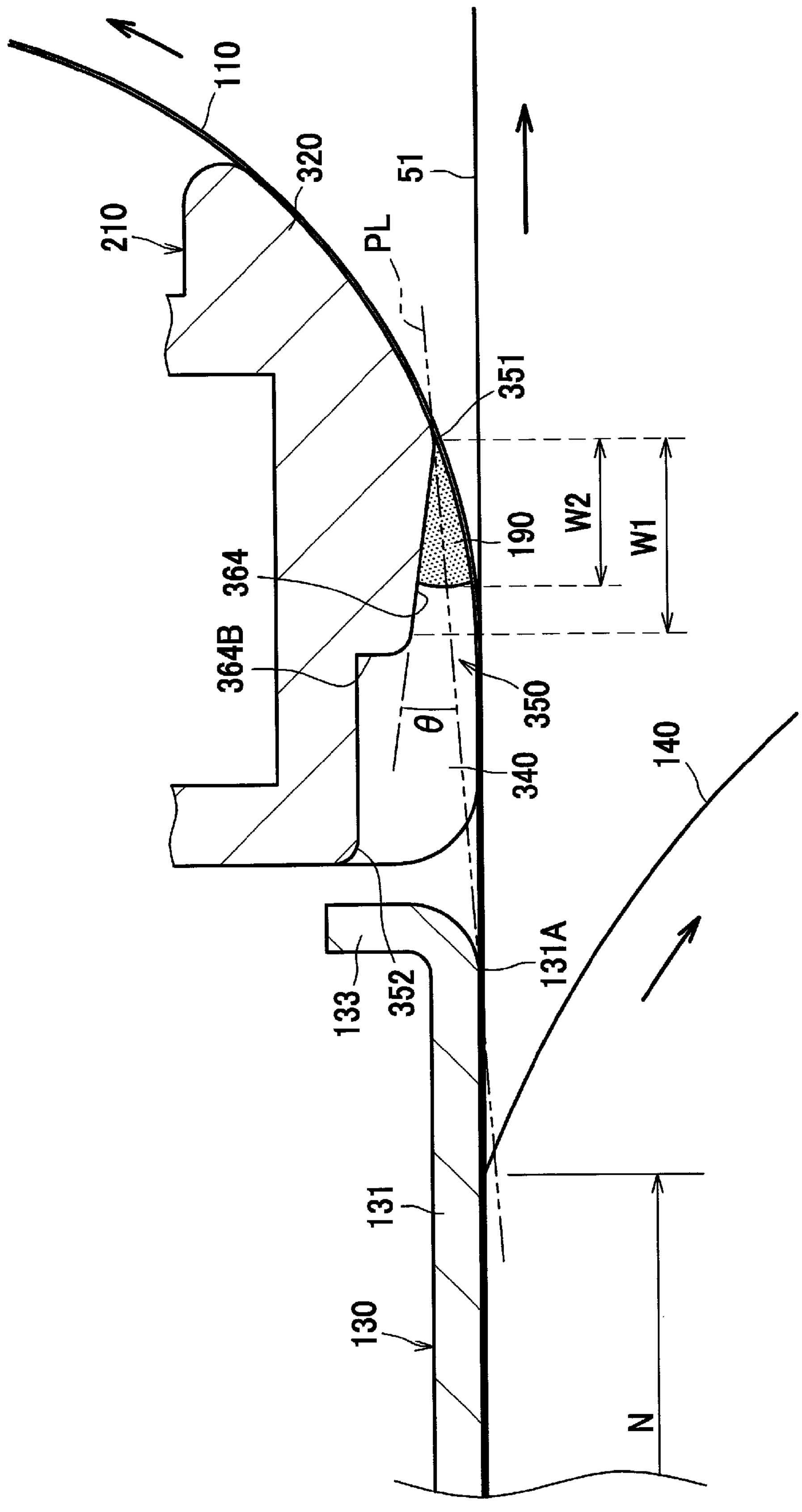
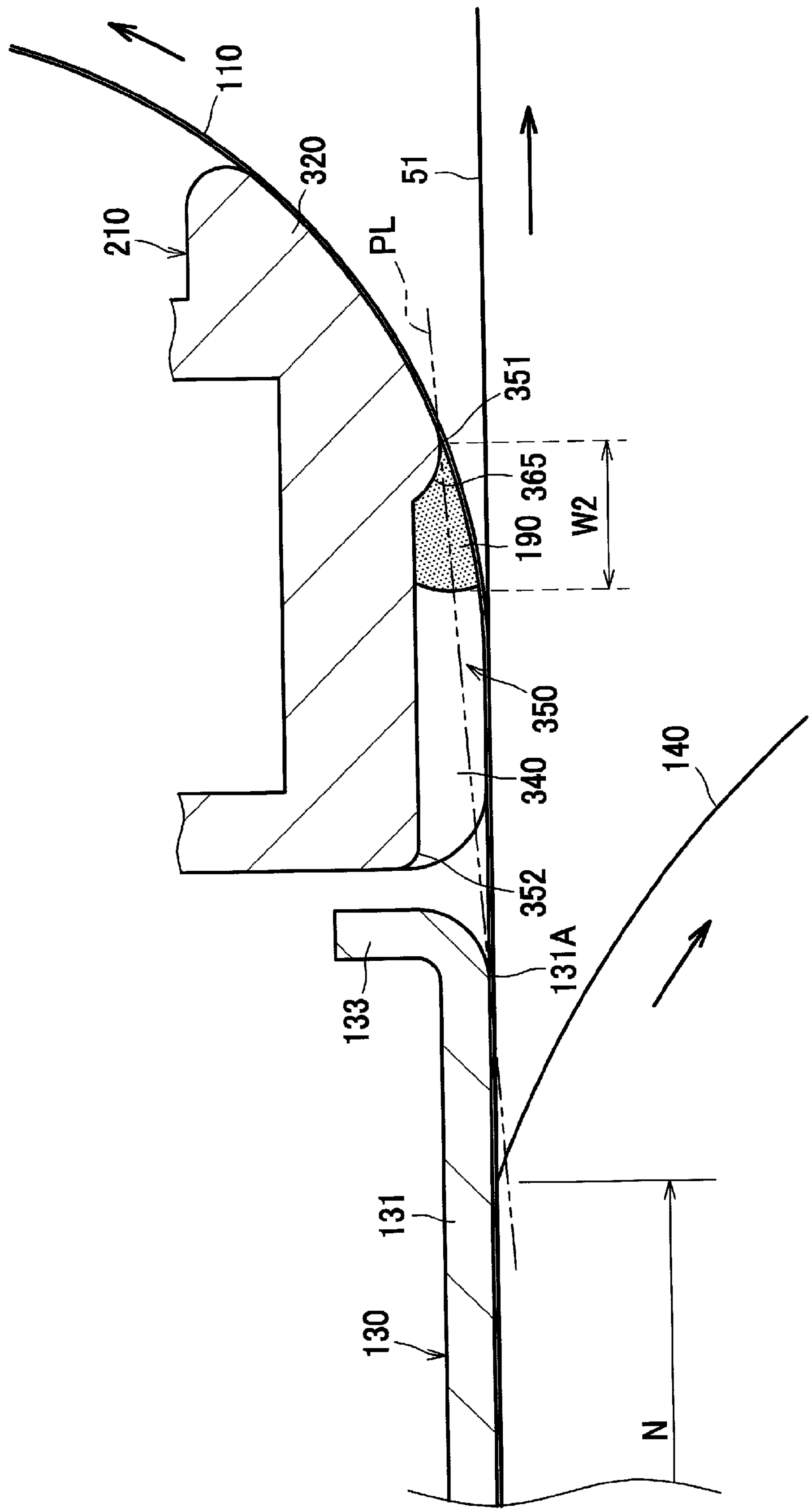

110
320
51
210
PL
351
W2
W1
190
364
364B
350
θ
340
140
131A
133
352
131
130
N

FIG.10


110
320
210
51
PL
351
365
190
W2
350
340
352
131A
140
133
131
130
N

# FIXING DEVICE

## CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Applications No. 2014-198794 filed on Sep. 29, 2014 and No. 2015-146420 filed on Jul. 24, 2015, the entire subject matter of which is incorporated herein by reference.

## TECHNICAL FIELD

The present disclosure relates to a fixing device for thermally fixing a developer image on a recording sheet.

## BACKGROUND ART

A fixing device for thermally fixing a developer image on a recording sheet such as a paper sheet is disclosed, and the fixing device includes an endless belt, a nip member that comes into sliding contact with the inner circumferential surface of the endless belt, a pressure roller that forms a nip between the endless belt and the pressure roller, and a guide member that is disposed downstream from the nip in the rotational direction of the endless belt and guides the endless belt getting out of the nip between the nip member and the pressure roller.

In the fixing device, the guide member includes a downstream guide that guides the endless belt and a depressed portion that is formed between the nip and the downstream guide, and a gap is formed between the endless belt and the guide member by the depressed portion. Accordingly, it is possible to suppress heat of the endless belt from being lost to the guide member or to reduce sliding resistance between the endless belt and the guide member.

## SUMMARY

However, since a lubricant is provided between the endless belt and the nip member or the like, the lubricant attached to the inner circumferential surface of the endless belt may be scraped out with the depressed portion of the guide member and may flow into the depressed portion. Among the lubricant flowing into the depressed portion, the lubricant which is present close to the endless belt is taken out by the endless belt and is used for lubrication again, but there is a possibility that the lubricant which is present apart from the endless belt stays in the depressed portion and is not used for lubrication. When a part of the lubricant is not used for lubrication, for example, an amount of lubricant between the endless belt and the nip member or the like may not be sufficient and sliding resistance of the endless belt may increase.

In consideration of the above-mentioned circumstances, the present disclosure is to provide a fixing device capable of suppressing an increment of sliding resistance of an endless belt.

A fixing device of the present disclosure includes: an endless belt, which is rotatable; a nip member, which includes a contact portion capable of being in contact with an inner circumferential surface of the endless belt; a backup member, wherein a nip between is formed between the endless belt and the backup member with interposing the endless belt between the nip member and the backup member; and a guide member. The guide member includes: a guide portion, which is disposed downstream from the nip in a rotational direction of the endless belt and is configured to be in contact with the inner circumferential surface of the endless belt, and a gap forming portion, which is disposed between the nip and the guide portion in the rotational direction of the endless belt and which is separated from the endless belt to form a gap from the endless belt. The gap forming portion includes an inclined surface that extends from the guide portion toward upstream in the rotational direction and has a predetermined area, on which a lubricant is provided. A maximum inclination angle between the predetermined area and a plane that is defined to contact a downstream end, in the rotational direction, of the contact portion of the nip member and the guide portion is less than 90 degrees.

A fixing device of this disclosure includes: an endless belt, which is rotatable; a nip member, which includes a contact portion capable of being in contact with an inner circumferential surface of the endless belt; a backup member, wherein a nip between is formed between the endless belt and the backup member with interposing the endless belt between the nip member and the backup member; and a guide member. The guide member includes: a guide portion, which is disposed downstream from the nip in a rotational direction of the endless belt and is configured to be in contact with the inner circumferential surface of the endless belt, and a gap forming portion, which is disposed between the nip and the guide portion in the rotational direction of the endless belt and which is separated from the endless belt to form a gap from the endless belt. The gap forming portion includes an inclined surface that extends from the guide portion toward upstream in the rotational direction. A maximum inclination angle between an area that is located within 2 millimeters from a downstream end, in the rotational direction, of the gap forming portion and a plane that is defined to contact a downstream end, in the rotational direction, of the contact portion of the nip member and the guide portion is less than 90 degrees.

According to the configuration related to the inclined surface, since the lubricant collected between the endless belt and the inclined surface can be moved to the inner circumferential surface of the endless belt along the inclined surface by the rotation of the endless belt, it is possible to improve capability of supplying the lubricant to the inner circumferential surface of the endless belt. Accordingly, since a sufficient amount of lubricant can be interposed between the endless belt and the nip member, it is possible to suppress an increment of sliding resistance of the endless belt.

According to the disclosure, it is possible to suppress an increment of sliding resistance of the endless belt.

## BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and additional features and characteristics of this disclosure will become more apparent from the following detailed descriptions considered with the reference to the accompanying drawings, wherein:

FIG. **1** is a cross-sectional view illustrating a color laser printer including a fixing device according to an embodiment of the disclosure;

FIG. **2** is a cross-sectional view illustrating the fixing device;

FIG. **3** is a perspective view illustrating a nip plate;

FIG. **4** is a perspective view of a first cover member as viewed from the lower side;

FIG. **5** is an enlarged cross-sectional view of the periphery of a downstream guide;

FIG. **6** is an enlarged cross-sectional view of the periphery of a downstream guide in a fixing device according to a first modification example;

FIG. **7** is an enlarged cross-sectional view of the periphery of a downstream guide in a fixing device according to a second modification example;

FIG. **8** is an enlarged cross-sectional view of the periphery of a downstream guide in a fixing device according to a third modification example;

FIG. **9** is an enlarged cross-sectional view of the periphery of a downstream guide in a fixing device according to a fourth modification example; and

FIG. **10** is an enlarged cross-sectional view of the periphery of a downstream guide in a fixing device according to a fifth modification example.

## DETAILED DESCRIPTION

Hereinafter, embodiments of the disclosure will be described in detail properly with reference to the accompanying drawings. In the following description, unless particularly mentioned, an up-down direction in FIG. **1** denotes an up-down direction, a left side in FIG. **1** denotes a front side, a right side denotes a rear side, a back side in the drawing denotes a left side, a front side in the drawing denotes a right side. Here, the right and left sides are defined on a basis of a view of a person when the person stands on the front side of a color laser printer **1**.

Configuration of Color Laser Printer

As illustrated in FIG. **1**, the color laser printer **1** includes a sheet feeding unit **5** that feeds a sheet **51** (a recording sheet), an image forming unit **6** that forms an image on the fed sheet **51**, and a sheet discharging unit **7** that discharges the sheet **51** having an image formed thereon, in an apparatus body **2** thereof. The printer **1** outputs (discharges) the sheet **51**, on which the image is formed, by a throughput of 50 ppm (pages per minutes). The throughput of the printer **1** may be a range from 30 to 80 ppm or a range from 40 to 60 ppm.

The sheet feeding unit **5** includes: a sheet feeding tray **50** that is attached to and detached from the apparatus body **2** from the front side at the lower side of the apparatus body **2**; and a sheet feeding mechanism M1 that picks up a sheet **51** from the sheet feeding tray **50**, inverts the sheet **51** to the rear side, and conveys the sheet **51**.

The sheet feeding mechanism M1 includes a pickup roller **52**, a separation roller **53**, and a separation pad **54** which are installed in the vicinity of the front end of the sheet feeding tray **50**. The sheets **51** in the sheet feeding tray **50** are separated one by one and are conveyed upward by these elements. The sheet **51** conveyed upward passes between a paper dust removing roller **55** and a pinch roller **56**, passes through a conveyance path **57**, is inverted to the rear side, and is fed onto a conveyance belt **73** to be described later. While the sheet **51** is being passing between the paper dust removing roller **55** and the pinch roller **56**, paper dust attached to the sheet **51** is removed from the sheet **51** by the paper dust removing roller **55**.

The image forming unit **6** includes a scanner unit **61**, a process unit **62**, a transfer unit **63**, and a fixing device **100**.

The scanner unit **61** is formed at the upper part of the apparatus body **2** and includes a laser beam emitting unit, a polygon mirror, and plural lenses and mirrors, although not illustrated. In the scanner unit **61**, the right-left direction is scanned at a high speed with laser beams emitted from the laser beam emitting unit to correspond to colors of cyan, magenta, yellow, and black using the polygon mirror. The laser beams transmitted or reflected by the lenses and mirrors are applied to photosensitive drums **31** (see the dotted lines).

The process unit **62** is disposed below the scanner unit **61** and above the sheet feeding unit **5** and includes a photosensitive member unit **3** that is movable in the front-rear direction with respect to the apparatus body **2**. The photosensitive member unit **3** includes drum subunits **30** and developer cartridges **40** attached to the drum subunits **30**.

Each drum subunit **30** includes a known photosensitive drum **31** and a scorotron type charger **32**.

The developer cartridge **40** has toner (developer) contained therein and includes a known supply roller **41**, a developing roller **42**, and a thickness regulating blade **43**.

The process unit **62** functions as follows. The toner in the developer cartridge **40** is supplied to the developing roller **42** by the supply roller **41** and the toner is frictionally charged to the positive polarity between the supply roller **41** and the developing roller **42** at this time. The toner supplied to the developing roller **42** is rubbed by the thickness regulating blade **43** with the rotation of the developing roller **42** and is held as a thin layer with a constant thickness on the surface of the developing roller **42**.

On the other hand, in each drum subunit **30**, the scorotron type charger **32** evenly charges the photosensitive drum **31** to the positive polarity by corona discharge. The charged photosensitive drum **31** is irradiated with the laser beam from the scanner unit **61** and an electrostatic latent image corresponding to an image to be formed on the sheet **51** is formed on the photosensitive drum **31**.

When the photosensitive drum **31** rotates, the toner held on the developing roller **42** is supplied to the electrostatic image on the photosensitive drum **31**, that is, a part, which has been exposed to a laser beam and which has a decreased potential, on the surface of the photosensitive drum **31** which has been uniformly charged to the positive polarity. Accordingly, the electrostatic latent image on the photosensitive drum **31** is visualized and a toner image due to reversal development is held on the surface of the photosensitive drum **31** to correspond to the color toner.

The transfer unit **63** includes a driving roller **71**, a follower roller **72**, a conveyance belt **73**, a transfer roller **74**, and a cleaning unit **75**.

The driving roller **71** and the follower roller **72** are disposed to be separated in the front-rear direction in parallel with each other, and the conveyance belt **73** which is an endless belt is wound and suspended on these rollers. The outer surface of the conveyance belt **73** is in contact with the photosensitive drum **31**. The transfer roller **74** nipping the conveyance belt **73** between the photosensitive drum **31** and the transfer roller **74**, is disposed inside the conveyance belt **73**. A transfer bias is applied to the transfer roller **74** from a high-voltage board (not illustrated). When forming an image, the sheet **51** conveyed by the conveyance belt **73** is nipped by the photosensitive drum **31** and the transfer roller **74** and the toner image on the photosensitive drum **31** is transferred to the sheet **51**.

The cleaning unit **75** is disposed below the conveyance belt **73** and is configured to remove toner attached to the conveyance belt **73** and to drop the removed toner into a toner reservoir **76**.

The fixing device **100** is disposed in the back of the transfer unit **63** and thermally fixes the toner image transferred onto the sheet **51** to the sheet **51**. The fixing device **100** will be described later in detail.

In the sheet discharging unit **7**, a discharge-side conveyance path **91** of the sheet **51** is formed to extend upward from an exit of the fixing device **100** and to be inverted toward the front side. Plural conveyance rollers **92** conveying the sheet **51** are disposed in the discharge-side conveyance path **91**. A sheet discharging tray **93** on which the printed sheet **51** is piled is formed on the top surface of the apparatus body **2**, and the sheet **51** discharged from the discharge-side conveyance path **91** by the conveyance rollers **92** is piled on the sheet discharging tray **93**.

Detailed Configuration of Fuser Unit

As illustrated in FIG. **2**, the fixing device **100** mainly includes a fixing belt **110** as an example of the endless belt, a halogen lamp **120** (heater), a nip plate **130** as an example of the nip member, a pressure roller **140** as an example of the backup member, a reflective plate **150**, a stay **160**, a cover member **200** made of a resin.

As rotating of the pressure roller, the sheet **51** is conveyed through the fixing device **100** at a velocity of 300 mm per second. The velocity of the sheet **51** conveyed through the fixing device **100** may be a range from 200 to 800 mm per second, a range from 200 to 600 mm per second, or a range from 250 to 350 mm per second.

The fixing belt **110** is an endless (cylindrical) belt having heat resistance and flexibility and the rotation thereof is guided by guides (an upstream guide **310**, a downstream guide **320**, and end guides **330** and **340**) formed in the cover member **200**. Specifically, in this embodiment, the fixing belt **110** is formed as a metal belt including a metal base member and a resin with which the outer circumference of the substrate is coated. Additionally, this fixing belt **110** is formed as a resign belt, in which a main component of the base member is polyimide.

The fixing belt **110** may have a rubber layer on the metal surface and may further include a nonmetal protective layer which is formed by coating the surface of the rubber layer with fluorine or the like.

The fixing belt **110** is urged to the outside in the radial direction with a weak elastic urging force by a wire spring **201** disposed in the cover member **200**, and thus the fixing belt **110** is supplied with a tension from the wiring spring **201** and is movable in the radial direction.

A member for applying a tension to the fixing belt **110** is not limited to the wire spring **201**, but may be, for example, a leaf spring. The wire spring **201** is not necessary, and the fixing belt **110** may be configured to be movable in the radial direction by excluding the wire spring **201**.

In order to enhance slidability between the fixing belt **110** and the nip plate **130** or the like, grease **190** (see FIG. **5**) as an example of the lubricant is disposed on the inner circumferential surface of the fixing belt **110**. For example, fluorine-based grease having heat resistance can be used as the grease **190**. The grease **190** has a penetration of 250. The penetration of the grease **190** may be a range from 100 to 500, a range from 150 to 400, or a range from 180 to 370. The consistency in this embodiment indicates a worked penetration (25 degrees Celsius), which is measured by a measuring method defined in JIS K2220 7.

The halogen lamp **120** is a member, which heats the toner on the sheet **51** by emitting radiant heat to heat the nip plate **130** and the fixing belt **110** (nip N), and is disposed inside the fixing belt **110** with a predetermined gap from the inner surfaces of the fixing belt **110** and the nip plate **130**.

The nip plate **130** is a plate-shaped member that is disposed inside the fixing belt **110** and is supplied with radiant heat from the halogen lamp **120**, and the bottom surface (plate-shaped portion **131**) thereof is disposed to come in sliding contact with the inner circumferential surface of the fixing belt **110**. In this embodiment, the nip plate **130** is formed of a metal and is formed, for example, by bending an aluminum plate or the like having high heat conductivity than that of the stay **160** formed of steel to be described later. In case where the nip plate **130** is formed of aluminum, it is possible to enhance the heat conductivity of the nip plate **130**.

As illustrated in FIGS. **2** and **3**, the nip plate **130** includes a plate-shaped portion **131** as an example of the sliding contact portion, a front-side bent portion **132**, a rear-side bent portion **133**, and three detection target portions **134**A, **134**B, and **134**C.

The plate-shaped portion **131** is formed in a longitudinal plate shape which is perpendicular to the up-down direction and which is long in the right-left direction. The inner surface (top surface) of the plate-shaped portion **131** may be painted in black or may be provided with a heat absorbing member. According to this configuration, it is possible to efficiently absorb the radiant heat from the halogen lamp **120**.

The front-side bent portion **132** is formed to be bent upwards in a substantially arc shape from the front end of the plate-shaped portion **131**. Specifically, the front-side bent portion **132** is bent toward a flange **164** of the stay **160** and the top end surface thereof is supported by a flange **152** of the reflective plate **150** and the flange **164** of the stay **160**.

The rear-side bent portion **133** is formed to extend upward from the rear end of the plate-shaped portion **131**.

The three detection target portions **134**A, **134**B, and **134**C are portions, from which a temperature is detected by thermistors **400**A and **400**B or a thermostat **400**C, and are formed to extend backward from a part of the top end of the rear-side bent portion **133**.

As illustrated in FIG. **2**, the pressure roller **140** is a member that forms a nip N between the fixing belt **110** and the pressure roller **140** by nipping the fixing belt **110** between the nip plate **130** and the pressure roller **140**, and is disposed below the nip plate **130**. In this embodiment, in order to form the nip N, one of the nip plate **130** and the pressure roller **140** is elastically supported to the other. By rotating in a state in which the fixing belt **110** is interposed between the nip plate **130** and the pressure roller **140**, the pressure roller **140** rotates together with the fixing belt **110** to convey the sheet **51** to the rear side.

The pressure roller **140** includes a cylindrical roller body **141** and a shaft **142** which is inserted into the roller body **141** and which is rotatable together with the roller body **141**. An axis direction of the pressure roller **140** is along with a longitudinal direction of the nip plate **130**. The roller body **141** is configured to be elastically deformable. The pressure roller **140** is configured to be rotationally driven with the supply of a driving force from a motor (not illustrated) installed in the apparatus body **2**, and rotates the fixing belt **110** by a frictional force with the fixing belt **110** (or the sheet **51**) to follow the rotational driving. The sheet **51** onto which the toner image has been transferred is conveyed to a place (the nip N) between the pressure roller **140** and the heated fixing belt **110**, so that the toner image (toner) is thermally fixed.

The reflective plate **150** is a member that reflects radiant heat from the halogen lamp **120** toward the nip plate **130** and is disposed with a predetermined gap from the halogen lamp **120** so as to surround the halogen lamp **120** inside the fixing belt **110**.

The reflective plate **150** is formed, for example, by curving an aluminum plate or the like having high reflectance of infrared light and far-infrared light in a U shape in a cross-sectional view. More specifically, the reflective plate

**150** includes a reflective portion **151** having a U shape and flanges **152** extending outward in the front-rear direction from both edges (edges on the nip plate **130** side) in the front-rear direction of the reflective portion **151**.

The flanges **152** are nipped between the stay **160** and the nip plate **130**.

The stay **160** is a member receiving a load from the pressure roller **140** by supporting the nip plate **130** with the reflective plate **150** interposed therebetween, and is disposed to surround the halogen lamp **120** or the reflective plate **150** inside the fixing belt **110**. Here, the load refers to a reaction force of a force with which the nip plate **130** elastically supports the pressure roller **140** in the configuration in which the nip plate **130** elastically supports the pressure roller **140**.

Specifically, the stay **160** is formed in a U shape in a cross-sectional view by a top wall **161**, a front wall **162** extending downward from the front end of the top wall **161**, and a rear wall **163** extending downward from the rear end of the top wall **161**. The flange **164** extending to the front side is formed at the bottom end of the front wall **162**.

The stay **160** is formed, for example, by bending a steel sheet having relatively high rigidity.

The cover member **200** mainly includes, as an example of the guide member, a first cover member **210** formed of a resin and a second cover member **220** formed of a resin.

The first cover member **210** is formed to be a U shape in a cross-sectional view and to extend longitudinally in the right-left direction, and is disposed to cover the stay **160** on the opposite side of the halogen lamp **120** with respect to the stay **160**. In other words, the first cover member **210** is disposed on the opposite side of the nip plate **130** with respect to the stay **160**.

The first cover member **210** mainly includes a rear wall **211**, a front wall **212**, a top wall **213** extending to connect the top ends of the rear wall **211** and the front wall **212**, and an extension wall **214** extending backward from the bottom end of the rear wall **211**. An upstream guide **310** is formed at the bottom end of the front wall **212**, and a downstream guide **320** as an example of the guide portion is formed at the rear end of the extension wall **214**.

As illustrated in FIG. **2** and FIG. **4** which is a bottom view of the first cover member **210**, the upstream guide **310** is disposed upstream from the nip N in the rotational direction of the fixing belt **110** and is formed in a longitudinal shape extending in the right-left direction. The upstream guide **310** comes into sliding contact with the inner circumferential surface of the fixing belt **110** and guides the fixing belt **110** toward the nip N (a place between the nip plate **130** and the pressure roller **140**).

The downstream guide **320** is disposed downstream from the nip N in the rotational direction of the fixing belt **110** and is formed in a long shape continuously extending from one end of the fixing belt **110** to the other end in the width direction of the fixing belt **110**. The downstream guide **320** comes into sliding contact with the inner circumferential surface of the fixing belt **110** and guides the fixing belt **110** getting out of the nip N. Detailed configurations of the periphery of the downstream guide **320** will be described later.

As illustrated in FIG. **2**, the second cover member **220** is formed to extend longitudinally in the right-left direction and is disposed on the upper side of the first cover member **210** (the opposite side of the stay **160**) to cover a part of the first cover member **210**. The second cover member **220** includes a top wall **221**, a rear wall **222** extending downward from the rear end of the top wall **221**, and an extension wall **223** extending backward from the bottom end of the rear wall **222**. A pair of end guides **330** (of which only one is illustrated) that comes into sliding contact with the inner circumferential surfaces of both ends of the fixing belts **110** to guide the fixing belt **110** to the upstream guide **310** is formed at both ends in the right-left direction of the top wall **221**.

Detailed Configuration of Periphery of Downstream Guide

As illustrated in FIGS. **4** and **5**, the first cover member **210** includes a downstream guide **320** and a pair of end guides **340** and a gap forming portion **350**, which are disposed between the nip N and the downstream guide **320** in the rotational direction of the fixing belt **110**. The downstream guide **30** is a resign frame having heat tolerance, such as a liquid polymer, and is harder than the fixing belt **110**.

The pair of end guides **340** is disposed at positions corresponding to both ends of the fixing belt **110** in the width direction of the fixing belt **110**, and comes in sliding contact with the inner circumferential surfaces of both ends of the fixing belt **110** to guide the fixing belt **110** toward the downstream guide **320**. The end guides **340** are formed in a cross-sectional shape to be smoothly connected to the downstream guide **320**.

The gap forming portion **350** is formed as a depressed portion having a shape concave inward in the radial direction of the fixing belt **110** between a pair of end guides **340** in the width direction of the fixing belt **110**. As illustrated in FIG. **5**, the gap forming portion **350** is separated from the fixing belt, between the nip N and the downstream guide **320** in the rotational direction of the fixing belt **110**. Since the contact area between the fixing belt **110** and the first cover member **210** is small due to this gap G, it is possible to suppress heat of the fixing belt **110** from being lost to the first cover member **21** or to reduce sliding resistance between the fixing belt **110** and the first cover member **210**.

The gap forming portion **350** can be configured, for example, such that the length L**1** in the rotational direction of the fixing belt **110** is equal to or larger than 0.7 mm or is equal to or less than 5.2 mm.

In this embodiment, the bottom surface of the gap forming portion **350** is formed as an inclined surface inclined over the entire area from a downstream end **351** to an upstream end **352** in the rotational direction of the fixing belt **110**. Specifically, the inclined surface **360** is a surface which extends to approach the fixing belt **110** from the upstream end **352** of the gap forming portion **350** to the downstream end **351** and which is smoothly connected to the downstream guide **320**. Additionally, the inclined surface **360** extends from the nip plate **130** to the pressing roller **140**, as forwarding from the upstream end **350** of the gap forming portion **350** to the downstream end portion **351**.

The inclined surface **360** is formed such that an angle (maximum inclination angle) θ of the most inclined part with respect to a plane PL that is defined to be in contact with the downstream end **131**A of the plate-shaped portion **131** and the downstream guide **320** in the rotational direction of the fixing belt **110** is less than 90 degrees (is an acute angle). Accordingly, in any part of the inclined surface **360** in the rotational direction of the fixing belt **110**, the inclination angle with respect to the plane PL is less than 90 degrees. As a result, the inclined surface **360** is formed, for example, as a surface not having a part perpendicular to the plane PL.

Herein, “the inclination angle of (a part of) the inclined surface **360** with respect to the plane PL” indicates an angle, which is formed in a direction from the pressing roller **140** to the nip plate **130**, among angles formed by the part of the inclined surface **360** and the plane PL. That is, “the inclination angle of (a part of) the inclined surface **360** with respect to the plane PL" indicates a degree of opening of (a part of) the inclined surface **360**, in the up-down direction (direction from the pressing roller **140** to the nip plate **130**) with respect to the plane PL.

The maximum inclination angle θ is preferably equal to or less than 45 degrees, is more preferably equal to or less than 30 degrees, and is still more preferably equal to or less than 15 degrees. For example, the inclined surface **360** in this embodiment has a planar shape, and the inclination angle θ thereof with respect to the plane PL is about 8 degrees.

The maximum depth (the maximum depth in the depth from the guide surface of the end guide **340** for guiding the fixing belt **110** to the bottom surface of the gap forming portion **350**) D**1** of the gap forming portion **350** may be equal to or larger than 0.7 mm. For example, the maximum depth D**1** of the gap forming portion **350** in this embodiment is 0.7 mm.

As illustrated by hatching in FIG. **4**, the inclined surface **360** (the gap forming portion **350**) is intermittently formed in the right-left direction. In other words, plural inclined surfaces **360** and plural cutout portions **370** formed to divide the inclined surfaces **360** are alternately arranged in the right-left direction in the first cover member **210**. When the cover member **200** and the nip plate **130** are attached, the detection target portions **134**A, **134**B, and **134**C (see FIG. **3**) are disposed in three cutout portions **370** from the right side.

According to the above-mentioned embodiment, as illustrated in FIG. **5**, even when the grease **190** is collected between the fixing belt **110** and the inclined surface **360**, the grease **190** can be moved to the inner circumferential surface of the fixing belt **110** along the inclined surface **360** with the rotation of the fixing belt **110**, and specifically the grease **190** can be moved between the fixing belt **110** and the downstream guide **32**. That is, according to this embodiment, capability of supplying the grease **190** to the inner circumferential surface of the fixing belt **110** can be enhanced by the inclined surface **360**. Accordingly, since the sufficient grease **190** can be interposed between the fixing belt **110** and the nip plate **130** or the like, it is possible to suppress an increment of sliding resistance of the fixing belt **110**.

The disclosure is not limited to the above-mentioned embodiment, but may be modified in various forms as will be described below. In the following description, members having substantially the same structures as in the above-mentioned embodiment will be referenced by the same reference numerals and description thereof will not be repeated.

In the above-mentioned embodiment, the inclined surface **360** has a planar shape, but the disclosure is not limited to this shape. For example, as illustrated in FIG. **6**, the cross-section of an inclined surface **361** as viewed from the width direction of the fixing belt **110** may have a convex curved shape which is convex in the direction approaching the fixing belt **110**. Alternatively, as illustrated in FIG. **7**, the cross-section of an inclined surface **362** as viewed from the width direction of the fixing belt **110** may have a concave curved shape which is concave in the direction separating from the fixing belt **110**.

In the above-mentioned embodiment, the inclined surface **360** is formed over the entire area of the gap forming portion **350** in the rotational direction of the fixing belt **110**, but the disclosure is not limited to this configuration. For example, as illustrated in FIG. **8**, an inclined surface **363** may be formed in only a predetermined area W**1** from the downstream end **351** of the gap forming portion **350** in the rotational direction of the fixing belt **110** to the upstream side in the rotational direction of the fixing belt **110**. Specifically, in the example illustrated in FIG. **8**, the inclined surface **363** is formed in a substantially half of a downstream part of the gap forming portion **350** in the rotational direction of the fixing belt **110**. In this configuration, the inclined surface **363** may have a planar shape as illustrated in FIG. **8** or may have the same curved shape as illustrated in FIG. **6** or **7**.

In the above-mentioned embodiment, the inclined surface **360** is formed such that the maximum inclination angle θ thereof with respect to the plane PL is 90 degrees or less as a whole, but the disclosure is not limited to this configuration. For example, as illustrated in FIG. **9**, an inclined surface **364**, specifically the bottom surface of the gap forming portion **350**, may have a part in which the maximum inclination angle θ with respect to the plane PL is less than 90 degrees in an area W**2** on which the grease **190** is collected between the fixing belt **110** and the gap forming portion **350** from the downstream end **351** of the gap forming portion **350**, and the maximum inclination angle θ with respect to the plane PL is equal to or greater than 90 degrees in an area upstream from the area W**2**. Specifically, in the example illustrated in FIG. **9**, the bottom surface of the gap forming portion **350** has a part (stepped portion **364**B) forming an angle of 90 degrees or more with respect to the plane PL in a part upstream from the area W**2** on which the grease **190** is collected and upstream from the predetermined area W**1**. Since the grease **190** is not collected in the vicinity of the stepped portion **364**B in spite of the stepped portion **364**B, a problem that the grease **190** is not used for lubrication does not occur.

The area W**2** on which the grease **190** is collected becomes often about 2 millimeters from the downstream end **351** of the gap forming portion **350** in the rotational direction of the fixing belt **110**. Accordingly, in the inclined surface **364** (the bottom surface of the gap forming portion **350**) according to the disclosure, it can be said that the maximum inclination angle θ with respect to the plane PL in the area within 2 millimeters from the downstream end **351** of the gap forming portion **350** is less than 90 degrees. The area W**2** on which the grease **190** is collected varies depending on the quantity of the grease **190** disposed on the inner circumferential surface of the fixing belt **110** or the like, and thus the area may be narrower than 2 millimeters.

As illustrated in FIG. **10**, an inclined surface **365** may be formed in a downstream part from the area W**2** on which the grease **190** is collected. In the example illustrated in FIG. **10**, a cross-section of the inclined surface **365** as viewed from the width direction of the fixing belt **110** has a convex curved shape which is convex in the direction approaching the fixing belt **110**. More specifically, the cross-section of the inclined surface **365** as viewed from the width direction of the fixing belt **110** has a substantially arc shape.

In the above-mentioned embodiment, the first cover member **210** in which the downstream guide **320** or the gap forming portion **350** as a part of the guide member is disposed downstream from the nip N in the rotational direction of the fixing belt **110** is exemplified as the guide member, but the disclosure is not limited to this example. For example, the whole part of the guide member may be disposed downstream from the nip in the rotational direction of the fixing belt.

In the above-mentioned embodiment, the pressure roller **140** is exemplified as the backup member, but the disclosure is not limited to this configuration and, for example, a pressure member having a belt shape may be used.

In the above-mentioned embodiment, the nip plate **130** is exemplified as an example of the nip member, but the disclosure is not limited to this configuration and a thick member may be used instead of a plate shape.

In the above-mentioned embodiment, the disclosure is applied to the color laser printer **1**, but the disclosure is not limited to this configuration. For example, the disclosure may be applied to other image forming apparatuses such as a copying machine and a multifunction machine.

The fixing belt may be formed of a resin film containing polyimide as a main component. In this case, the surface layer of the fixing belt is coated with a fluororesin such as PTFE.

What is claimed is:

**1**. A fixing device comprising:

an endless belt;

a nip member, which includes a contact portion capable of being in contact with an inner circumferential surface of the endless belt;

a backup member, wherein a nip, where the endless belt is to rotate in a rotational direction, is formed between the endless belt and the backup member with the endless belt being interposed between the nip member and the backup member; and

a guide member, wherein the guide member includes:

a guide portion, which is disposed downstream from the nip in the rotational direction of the endless belt and is configured to be in contact with the inner circumferential surface of the endless belt; and

a gap forming portion, which is disposed between the nip and the guide portion in the rotational direction of the endless belt and which is separated from the endless belt to form a gap between the endless belt and the gap forming portion,

wherein the gap forming portion includes an inclined surface that extends from the guide portion toward upstream in the rotational direction and has a predetermined area, on which a lubricant is provided,

wherein a maximum inclination angle between the predetermined area and a plane that is defined to contact a downstream end, in the rotational direction, of the contact portion of the nip member and the guide portion is less than 90 degrees, and

wherein a penetration of the lubricant is a range from 100 to 500.

**2**. The fixing device according to claim **1**, wherein the gap forming portion is a depressed portion, and a maximum depth of the gap forming portion is equal to or larger than 0.7 mm.

**3**. The fixing device according to claim **1**, wherein a length of the gap forming portion in the rotational direction is equal to or larger than 0.7 mm and is equal to or less than 5.2 mm.

**4**. The fixing device according to claim **1**, wherein the inclined surface is formed to extend from a downstream end of the gap forming portion to an upstream end of the gap forming portion in the rotational direction.

**5**. The fixing device according to claim **1**, wherein a cross-sectional shape of the inclined surface as viewed from a longitudinal direction of the nip member is an arc shape protruding toward the inner circumferential surface of the endless belt.

**6**. The fixing device according to claim **1**, wherein a cross-sectional shape of the inclined surface as viewed from a longitudinal direction of the nip member is a concave shape separating from the inner circumferential surface of the endless belt.

**7**. The fixing device according to claim **3**, wherein the maximum inclination angle is equal to or less than 30 degrees.

**8**. The fixing device according to claim **3**, wherein the maximum inclination angle is equal to or less than 15 degrees.

**9**. The fixing device according to claim **1**, wherein a conveyance velocity of a sheet at the nip is a range from 200 to 800 mm per second.

**10**. A fixing device comprising:

an endless belt, which is rotatable;

a nip member, which includes a contact portion capable of being in contact with an inner circumferential surface of the endless belt;

a backup member, wherein a nip is formed between the endless belt and the backup member with the endless belt being interposed between the nip member and the backup member; and

a guide member, wherein the guide member includes:

a guide portion, which is disposed downstream from the nip in a rotational direction of the endless belt and is configured to be in contact with the inner circumferential surface of the endless belt, and

a gap forming portion, which is disposed between the nip and the guide portion in the rotational direction of the endless belt and which is separated from the endless belt to form a gap from the endless belt,

wherein the gap forming portion includes an inclined surface that extends from the guide portion toward upstream in the rotational direction, and on which a lubricant is provided,

wherein a maximum inclination angle between an area that is located within 2 millimeters from a downstream end, in the rotational direction, of the gap forming portion and a plane that is defined to contact a downstream end, in the rotational direction, of the contact portion of the nip member and the guide portion is less than 90 degrees, and

wherein a penetration of the lubricant is a range from 100 to 500.

**11**. The fixing device according to claim **10**, wherein the gap forming portion is a depressed portion, and a maximum depth of the gap forming portion is equal to or larger than 0.7 mm.

**12**. The fixing device according to claim **10**, wherein a length of the gap forming portion in the rotational direction is equal to or larger than 0.7 mm and is equal to or less than 5.2 mm.

**13**. The fixing device according to claim **10**, wherein the inclined surface is formed to extend from a downstream end of the gap forming portion to an upstream end of the gap forming portion in the rotational direction.

**14**. The fixing device according to claim **10**, wherein a cross-sectional shape of the inclined surface as viewed from a longitudinal direction of the nip member is an arc shape protruding toward the inner circumferential surface of the endless belt.

**15**. The fixing device according to claim **10**, wherein a cross-sectional shape of the inclined surface as viewed from a longitudinal direction of the nip member is a concave shape separating from the inner circumferential surface of the endless belt.

**16**. The fixing device according to claim **12**, wherein the maximum inclination angle is equal to or less than 30 degrees.

**17**. The fixing device according to claim **12**, wherein the maximum inclination angle is equal to or less than 15 degrees.

**18**. The fixing device according to claim **10**, wherein a conveyance velocity of a sheet at the nip is a range from 200 to 800 mm per second.

**19**. The fixing device according to claim **1**, further comprising:

a halogen lamp, which is provided at an inside of the endless belt,

wherein the nip member includes a plate-shaped member.

**20**. The fixing device according to claim **10**, further comprising:

a heater, which is provided at an inside of the endless belt,

wherein the nip member includes a metal plate and is arranged to receive radiant heat from the heater.

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